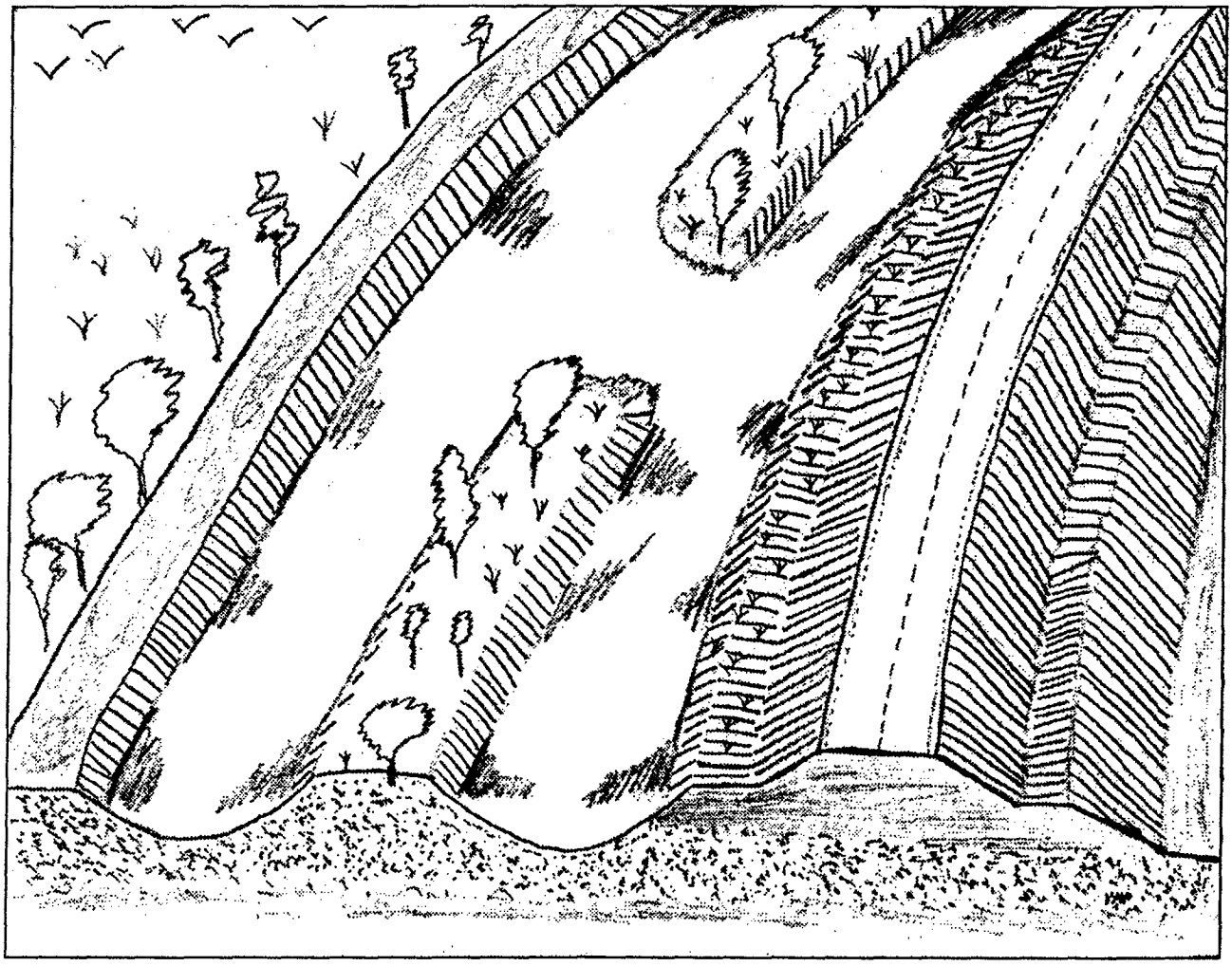
CALFED Delta Levee System Integrity Program



Delta Long-Term Levee System Protection Plan
Draft
October 1997

Reduce the risk to land use and commerce, water supply, infrastructure, and ecosystem, from catastrophic breaching of Delta levees

CALFED
BAY-DELTA
PROGRAM

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DELTA LEVEE SYSTEM INTEGRITY PROGRAM

Foreword

This program, like all components of the Program's alternatives, is being developed and evaluated at a programmatic level. The complex and comprehensive nature of a Bay-Delta solution means that it will be composed of many different programs and activities that will be implemented over time. Solution alternatives will be evaluated as sets of programs and activities so that broad benefits and impacts can be identified. More focused analysis and environmental documentation of specific programs and actions will occur in subsequent refinement efforts.

TABLE OF CONTENTS

LIST OF FIGURES

APPENDICES

Glossary

The following terms are used in describing the Delta Levee System Integrity Program:

Action - A physical, operational, legal, or institutional change intended to maintain or achieve a desirable condition (target) of the Delta levee system.

Channel islands - Small unleveed land masses within Delta channels which typically provide good wildlife habitat. Some are remnants of original Delta marsh lands and others are the result of channel widening, levee construction, and dredged material disposal.

Delta islands - Islands in the Sacramento-San Joaquin Delta protected by levees. The surface of the majority of islands are below sea level and provide many benefits including agriculture, recreation, water quality, and habitat for fish and wildlife.

Drainage blanket - A layer of crushed rock which may be encapsulated in filter fabric that is placed on the slope and landside toe of a levee prior to placement of a stability berm. It helps to control seepage and piping.

Erosion - Loss of levee material due to the effects of channel flows, tidal action, boat wakes, and wind-generated waves.

Ecosystem Restoration Program Plan - A comprehensive plan for restoration and management of the Bay-Delta ecosystem, including upstream tributaries and watersheds.

Hydrostatic pressure - The pressure of water at a given depth resulting from the weight of the water above it.

Implementation Objective - A description of what the program will strive to maintain or achieve for the Delta levee system which is not intended to change over the life of the program.

Levee crown - The top surface between the edges of a levee.

Liquefaction - The process in which a saturated sandy soil loses strength when subjected to ground shaking during an earthquake.

Non-project levee - A flood control levee in the Delta that is not a federal flood control project levee.

Oxidation - The conversion of organic soil, such as peat, to carbon dioxide.

Piping - The process of seepage carrying away levee material resulting in larger seepage paths within the levee.

Primary zone - The Delta land and water area of primary state concern and statewide significance which is situated within the boundaries of the Delta, but which is not within either the urban limit line or sphere of influence line of any government's general plan or currently existing studies, as of January 1, 1992 (Delta Protection Act of 1992).

Project levee - A flood control levee which is part of a federal flood control project.

Reclamation district - A local agency responsible for the maintenance of levees within their boundaries.

Seepage - A slow movement of water through permeable soils caused by hydrostatic pressure.

Seismicity - The frequency, intensity, and distribution of earthquake activity in an area.

Setback levee - A constructed embankment to prevent flooding that is positioned some distance from the edge of the river or channel. Setback levees provide area for wildlife habitat to develop and for floodflow capacity.

Settlement - The sinking of surface elevations as a result of underlying soil consolidation caused by an increase in the weight of overlying deposits, the movement of foundation materials, or the extrusion of water.

Slope protection - Various types of materials used to protect the levee surface and streambank adjacent to the levee from erosion.

Slurry cutoff wall - A combination of soil, cement, and bentonite (a clay material) constructed inside a trench down the center of the levee. This trench must be sufficiently deep to cut off or reduce seepage through or under the levee.

Stability berm - Earth fill placed against the levee slope to act as a counterweight to prevent rotational slides.

Subsidence - The loss of soil within the first few feet of the surface due to organic soil oxidation and topsoil erosion is referred to as shallow subsidence. Deep subsidence is caused by groundwater withdrawal and a decline of natural gas pressure due to gas extraction wells.

Target - A qualitative or quantitative statement of an implementation objective. Targets may vary as new information becomes available and may vary based on Delta conveyance alternatives. Targets are to be set based on realistic expectations, must be balanced against other resource needs, and must be reasonable, affordable, cost effective, and practicably achievable.

Toe drain - A trench along the landside toe of the levee. Generally, it is an open ditch, but sometimes it is filled with crushed rock encapsulated in filter fabric. The toe drain reduces saturation of the levee, controls seepage, and helps prevent boils.

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CALFED Bay-Delta Program

DELTA LEVEE SYSTEM INTEGRITY PROGRAM

Objective

Reduce the risk to land use and associated economic activities, water supply, infrastructure, and the ecosystem from catastrophic breaching of Delta levees.

Vision

The Sacramento-San Joaquin Delta is an area of great regional and national importance, which provides a broad array of benefits including agriculture, water supply, transportation, navigation, recreation and fish and wildlife habitat. Delta levees are the most visible and critical feature of this system.

Historically, the levee system has been viewed as a means of protecting other Delta resources. However, levees are an integral part of the Delta landscape and are key to preserving the Delta's physical characteristics and processes. A goal for the program is to integrate their role in defining the waterways and islands with long-term ecosystem restoration of the Bay-Delta system.

Given the numerous public benefits protected by Delta levees, the focus of the Delta Levee System Integrity Program is to supplement and improve Delta levee maintenance and emergency management practices. Developing a mechanism to ensure long-term availability of funding to implement the Delta Levee System Integrity Program and equitable distribution of the costs is an important component of the Finance and Assurances Implementation Strategy for the overall CALFED Bay-Delta Program.

Introduction

The mission of the CALFED Bay-Delta Program is to develop a long-term comprehensive plan that will restore ecosystem health and improve water management for beneficial uses of the Bay-Delta system. CALFED addresses problems in four resource areas: ecosystem quality, water quality, system integrity, and water supply reliability. Programs are designed and integrated to address problems in the four resource areas to fulfill the CALFED mission.

The Delta levee system provides protection to:

- Delta communities
- Existing land use
- Water quality
- Ecosystem
- Infrastructure
- Economic activities
- Water supply operations

These resources are at risk from potential failure of the Delta levees and channels and flooding of Delta islands. Water supply operations and water quality are at risk from increased salinity intrusion which could result from the sudden catastrophic inundation of Delta islands.

The focus of the Delta Levee System Integrity Program is to provide long-term protection for multiple Delta resources by maintaining and improving the integrity of the Delta levee system. In addition, this program aims to integrate ecosystem restoration and Delta conveyance actions with levee improvement activities. Improvements in the reliability of water quality will be a natural by product of this program.

Background

Delta islands, of which the majority have land surface elevations below sea level, provide many benefits including agriculture, transportation, water quality, recreation, and fish and wildlife habitat. Natural settling of the levees and shallow subsidence of Delta island soils (oxidation which lowers the level of the land over time) has resulted in a need to increase levee heights to maintain protection. This increased height, coupled with poor levee construction and inadequate maintenance, makes Delta levees vulnerable to failure, especially during earthquakes or floods.

The following reclamation and water management activities greatly influenced the current Delta which includes over 700,000 acres, 700 miles of meandering waterways and over 1,100 miles of levees.

1849 Settlers began arriving in the Delta to farm its rich soils. The majority of the Delta was marsh land prior to subsequent reclamation and conversion to agricultural lands.

1850 Congress passed the Federal Swamp and Overflow Act, which provided for the title of wetlands to be transferred from the federal government to the states.

1861 California legislature authorized the State Reclamation District Act. As a result of state and federal legislation, swamp and overflow land was sold and reclaimed for agricultural use by construction of levees. The Delta was transformed from a large tidal marsh to a system of improved channels and levees by the early 1900s.

1933 Congress authorized the Central Valley Water Project (CVP).

The Stockton Deep Water Ship Channel, which extends from the confluence of the Sacramento and San Joaquin Rivers to the City of Stockton, was completed.

1940 The Contra Costa Canal, which exports water from the south Delta to the Bay Area, was completed. This was the first unit of the CVP which utilized existing channels to convey water through the Delta for export.

1944 Shasta Dam and Reservoir, a key feature of the CVP used to capture and store water, was completed. This project provided additional water to Delta channels during low-flow periods.

1951 The Delta-Mendota Canal, which exports water from the Delta via the Tracy Pumping Plant to the San-Joaquin valley, was completed. This is another unit of the CVP which increases exports from the Delta.

The Delta Cross Channel, which aids transfer of water from the Sacramento River across the Delta to the Tracy Pumping Plant, was completed.

1959 The Delta Protection Act was enacted by the California Legislature to protect, conserve, develop, control, and use the waters of the Delta for the public good.

1960 Voters approved the State Water Resources Development Bond Act (also known as the Burns-Porter Act) to help finance the initial facilities of the State Water Project (SWP). These facilities included master levees, control structures, channel improvements, and appurtenant facilities in the Sacramento-San Joaquin Delta used for water conservation, water supply in the Delta, transferring water across the Delta, and flood and salinity control.

The Sacramento River Flood Control Project, authorized by Congress, was completed by the U.S. Army Corps of Engineers. This project incorporated and improved certain Delta levees to provide improved flood control for a portion of the Delta. These levees are commonly referred to as "project" levees.

1963 The Sacramento Deep Water Ship Channel, which extends from the confluence of the Sacramento and San Joaquin Rivers, was completed.

1967 Oroville Dam and Reservoir, which provides increased channel flows during low-flow periods, was completed. This is a key feature of the State Water Project (SWP) and includes the Feather River Fish Hatchery to replace spawning areas lost as a result of the Dam.

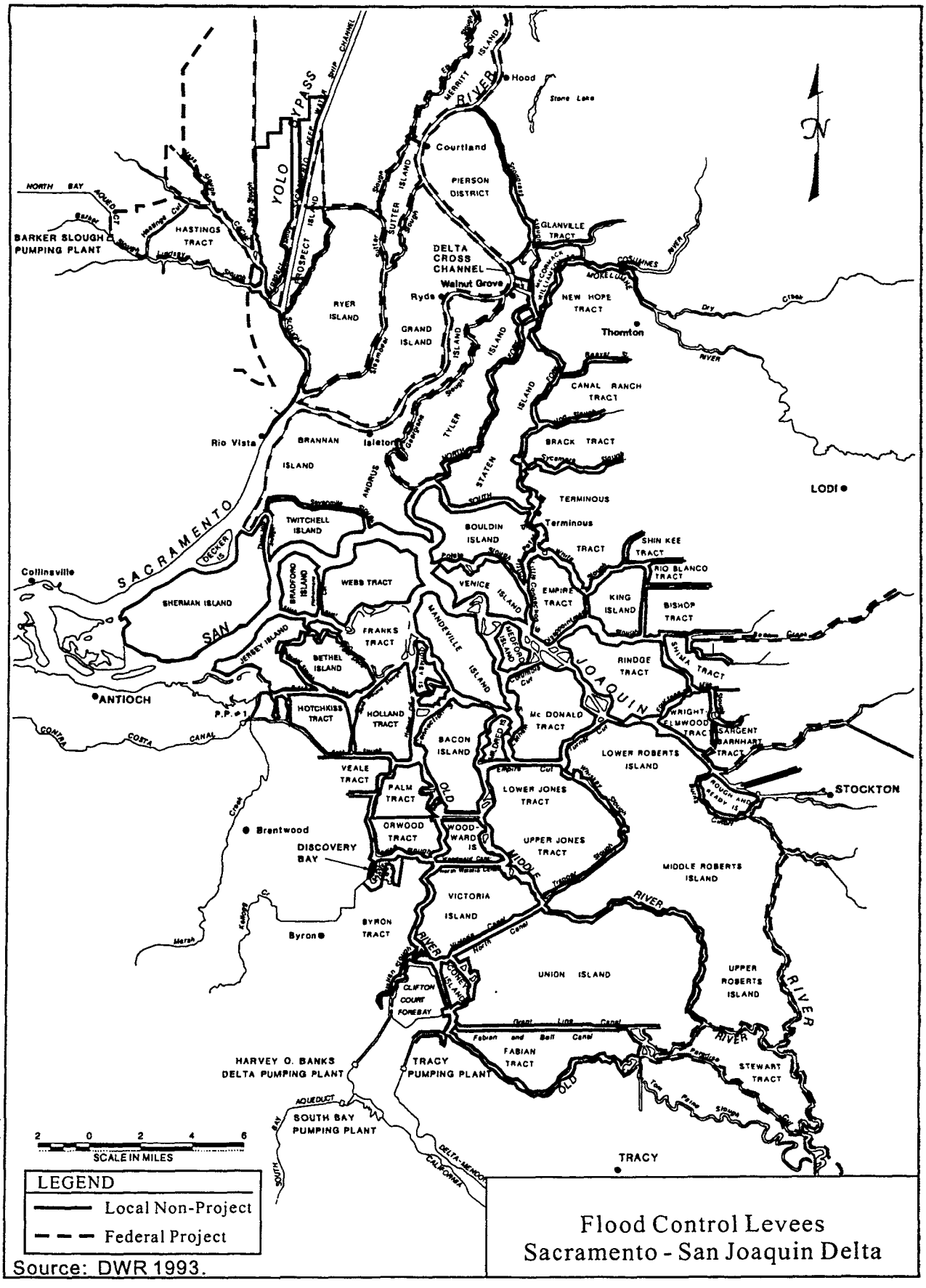
The first stage of the Harvey O. Banks Delta Pumping Plant, another unit of the SWP, was completed along with the John E. Skinner Fish Facility. Diversions from the Delta to the California and South Bay aqueducts of the SWP began.

Construction of Clifton Court Forebay located in the south Delta began. This is another unit of the SWP to facilitate export of water from the Delta.

1988 Barker Slough Pumping Plant, which provides water from the northwest Delta for the North Bay aqueduct, was completed.

Suisun Marsh salinity control gates, which aid in controlling water quality in the marsh for protection of waterfowl, was completed.

FIGURE 1

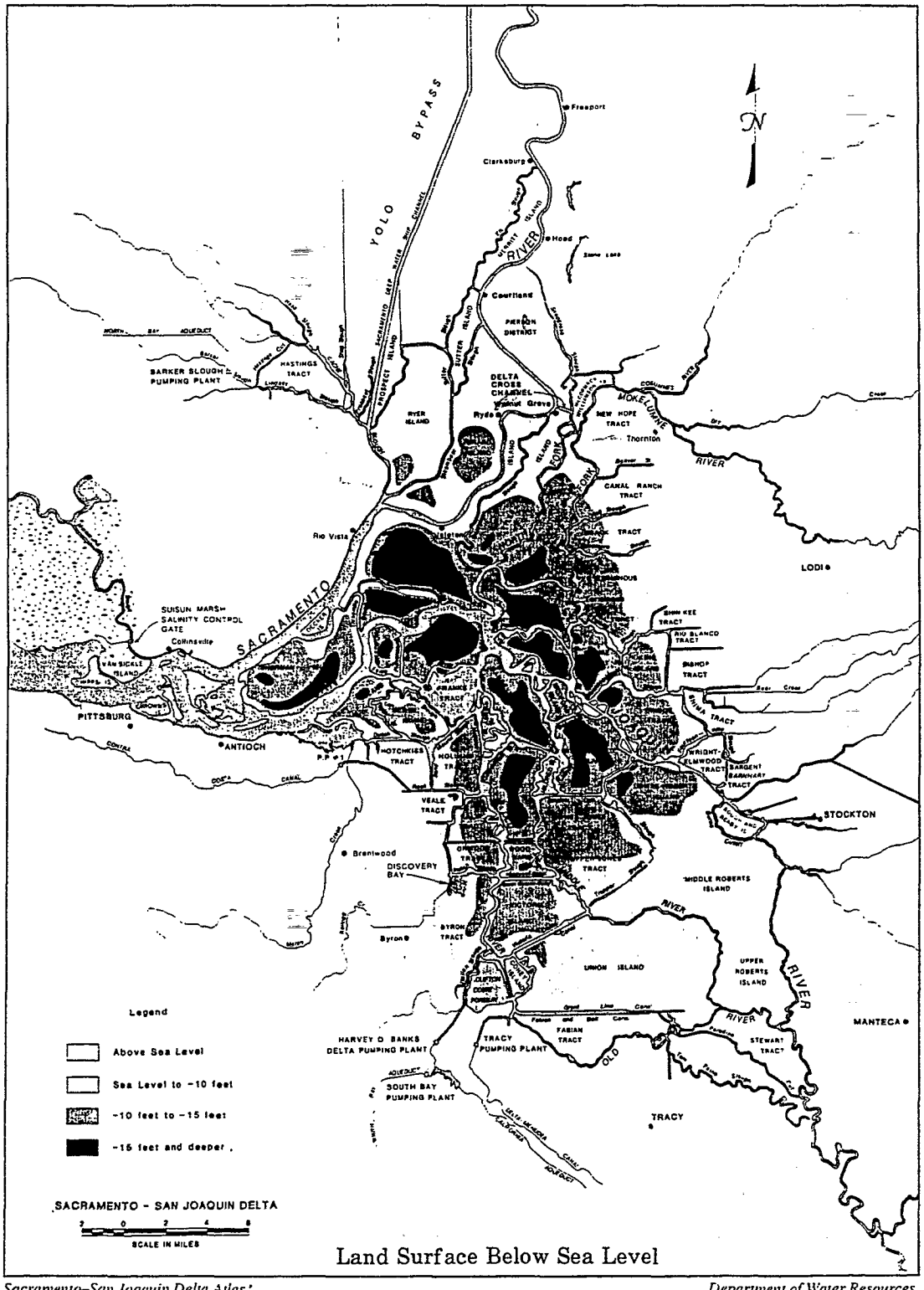


Inundation of one or more islands in the Delta can disrupt wildlife habitat, farming operations, and other land uses either permanently or for a significant period of time until repairs can be made. Inundation of roads, electric power lines, telephone lines, gas mains, and other infrastructure can cause lengthy delays in service. Several state highways and many Delta roads run along levees that are vulnerable to collapse due to erosion, seismic events, or overtopping. Major water distribution systems also pass through the Delta and are at risk of failure. Even if these numerous facilities survive the initial effects of inundation, long-term inundation would make continued maintenance and repair difficult, if not impossible. If a flooded island is not repaired and drained, the resulting large body of open water can expose adjacent islands to increased wave action and additional seepage.

Long-term flooding of key Delta islands can also affect water quality by changing the rate and extent of saltwater intrusion from San Francisco Bay. Inundation of one or more key islands in the western and central Delta would allow salinity to intrude further into the Delta. This would be of particular concern in a low water year when less freshwater would be available to repel the incoming salt water. This salinity intrusion would degrade water quality and could result in water supply interruption for in-Delta and export use by both urban and agricultural users, until the salt water could be flushed from the Delta. In order to lower salinity in the Delta to acceptable levels, flushing flows would need to be released from upstream reservoirs. Stored water supplies in these reservoirs could be seriously depleted.

The California Legislature recognized that the Delta levee system benefits many segments and interests of the public at large and approved a conceptual plan in 1973 to preserve the integrity of the Delta levee system. The Delta Levee Maintenance Subvention Program was enacted to provide state funding and technical assistance for maintenance and rehabilitation of non-project Delta levees. The Delta Flood Protection Act of 1988 (SB 34) created the Special Flood Control Project Program for eight islands in the western Delta and the towns of Thornton and Walnut Grove. This act also amended the Delta Levee Maintenance Subvention Program and established a special account in the California Water Fund for appropriation by the Legislature for mitigation activities. Later, SB 1065 amended SB 34.

FIGURE 2



Sacramento–San Joaquin Delta Atlas

Department of Water Resources

The Delta Protection Commission (DPC) was established by the Delta Protection Act of 1992. The Act acknowledges that agricultural land within the Delta is of significant value, including its function of providing open space and habitat for waterfowl using the Pacific Flyway. The DPC has prepared a regional long-term resource management plan for the Delta to protect, maintain, and, where possible, enhance and restore the overall quality of the Delta environment, including, but not limited to agriculture, wildlife habitat, and recreational activities. All local general plans for areas within the Primary zone and within the boundaries of the Delta are required to be consistent with the DPC regional plan. In addition, the Safe, Clean, Reliable Water Supply Act (Proposition 204) was approved by voters in 1996 to fund a variety of Delta improvements and local programs designed to address California water needs, including Delta levee system improvements.

Geographic Scope

The geographic scope of the CALFED Bay-Delta Program consists of the legally defined Delta, Suisun Bay (extending to the Carquinez Strait), and Suisun Marsh. The Delta Levee System Integrity Program is focused on the legally defined Delta. The relationship between Delta channels, tributaries to the Delta, and upstream watersheds may require actions within the geographic solution area defined by the Program to resolve Delta levee system problems.

FIGURE 3

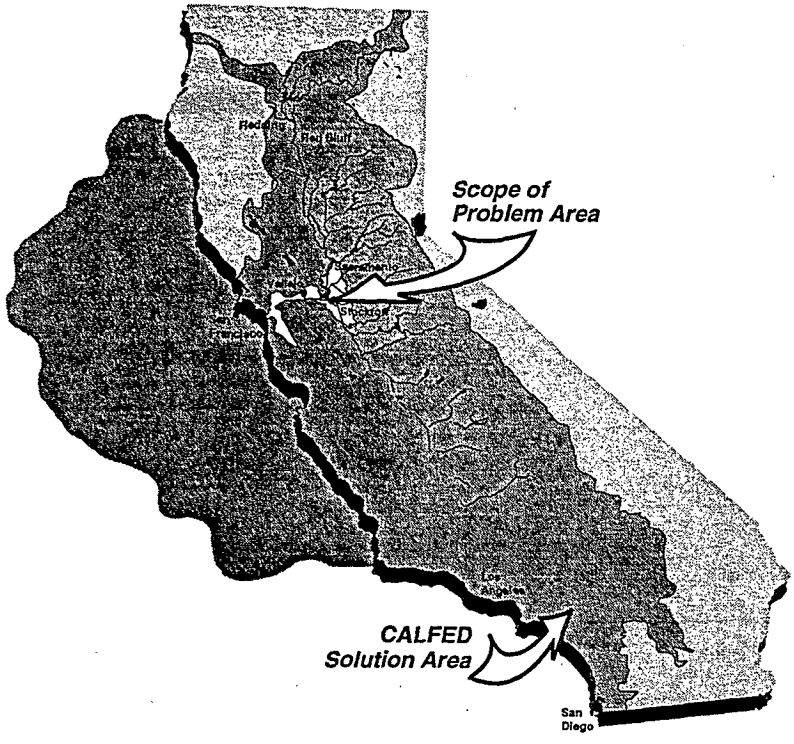
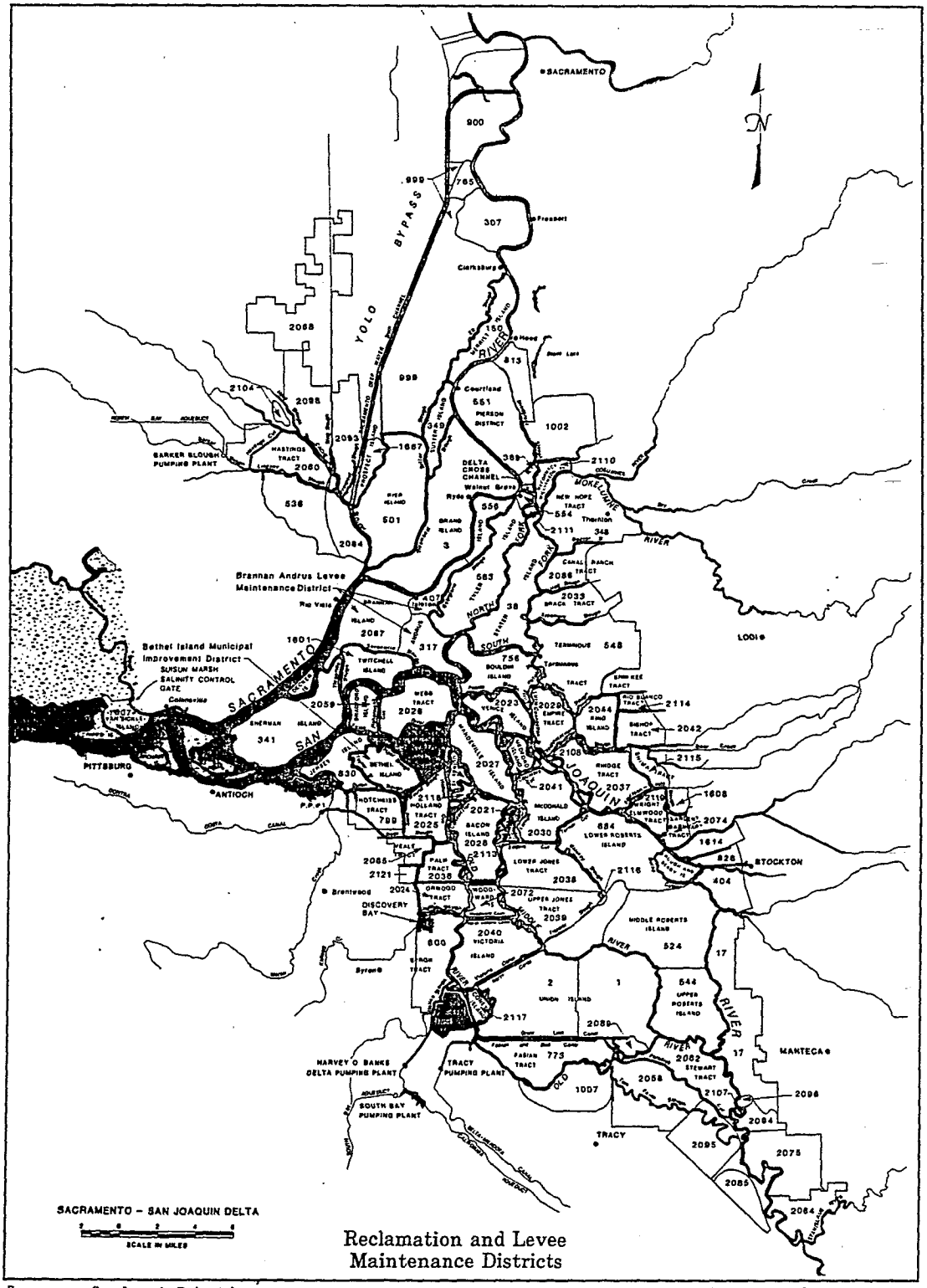


FIGURE 4



Sacramento–San Joaquin Delta Atlas *Department of Water Resources*

Implementation Strategy

The general approach for the Delta Levee System Integrity Program will be built upon a foundation of existing state, federal, and local agency programs. The focus of this program is to supplement and improve these existing programs where deficiencies are identified, and enhance opportunities to integrate ecosystem restoration with efforts to preserve and improve system integrity.

In most cases, system integrity problems are well understood and the actions needed to improve conditions are clear. In other cases, additional research is needed before potential solutions can be developed. Improvement of Delta levees and channels will require years of evaluation and coordination. For example, subsidence of Delta islands is well understood, but measures to slow or reverse the process are still being developed. Implementing this program will require reliable, long-term funding which distributes the costs of assuring long-term levee system integrity among all beneficiaries.

Ecosystem restoration and conveyance improvements will be integrated with levee improvements to protect existing Delta physical characteristics and processes. This integration will provide opportunities to address multiple problems in the Delta and to coordinate with other program actions.

Full implementation of this program will meet Public Law 84-99 (PL-99) performance criteria for project and non-project levees in the Delta. Over several decades, a phased process will coordinate potential improvement actions with ecosystem restoration and conveyance improvements. For example, actions to control subsidence can be implemented in conjunction with ecosystem restoration activities and provide an opportunity to continue investigation for reversing subsidence. Habitat improvements, such as creating corridors or Delta channel conveyance improvements, can provide opportunities for improvements for flood control. A comprehensive emergency management plan will be implemented to address protection and recovery of Delta resources in coordination with maintenance and improvement measures.

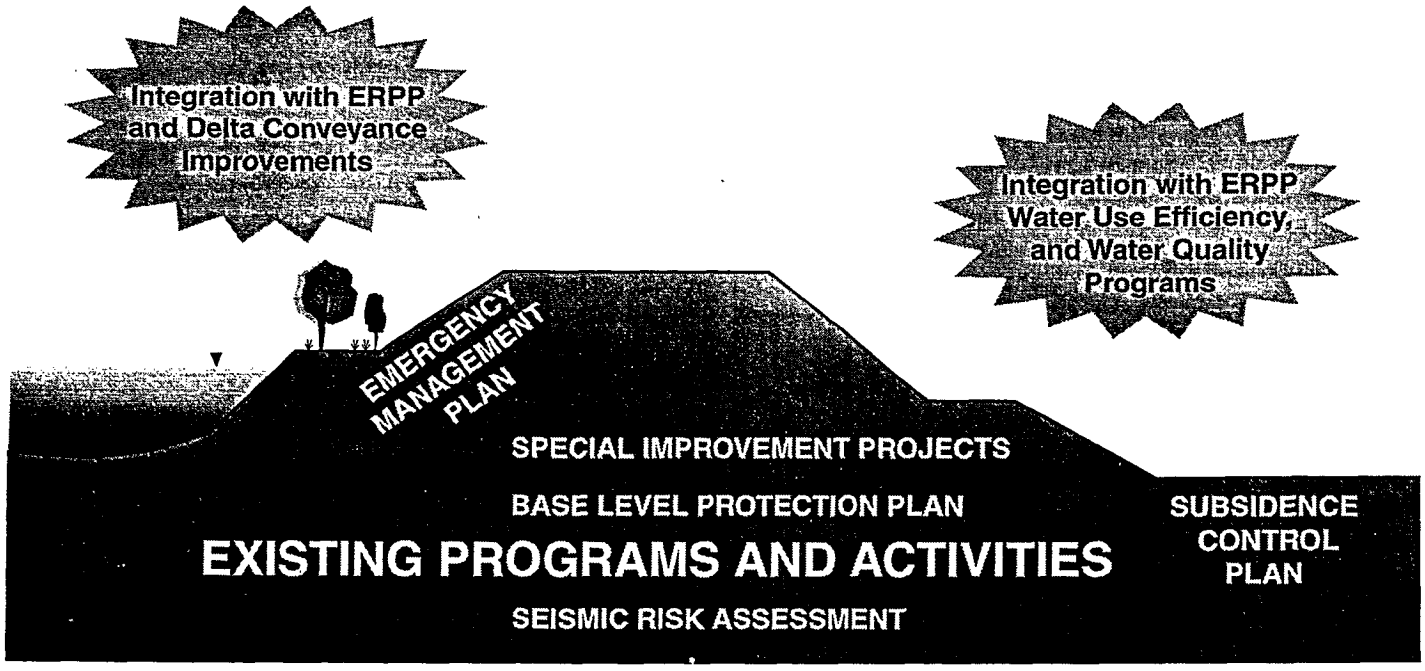
Program Elements

The specific elements of the Delta Levee System Integrity Program include:

- Delta Levee Base Level Protection Plan
- Delta Levee Special Improvement Projects
- Delta Island Subsidence Control Plan
- Delta Levee Emergency Management Plan
- Delta Levee Seismic Risk Assessment

FIGURE 5

Delta Levee System Integrity Program Elements



Program staff will work with stakeholders, the public, and state and federal agencies, to identify existing programs, potential deficiencies within existing programs, and specific actions for each element of the program to address any identified deficiencies. These actions will be closely integrated with the Ecosystem Restoration Program Plan and Delta conveyance actions to simultaneously increase system integrity, increase ecosystem quality, and protect water quality and water supply reliability.

Implementation Objective	Target	Action
Promote maintenance and enhancement of the Delta levee system.	Improve Delta levee system stability to meet PL 84-99 criteria	Modify levee cross sections by raising levee height, widening levee crown, flattening levee slopes, and/ or constructing stability berms.
Reduce degradation of the levee system and prevent long-term loss of habitat.	Establish uniform levee maintenance criteria to improve erosion and seepage control.	Provide slope protection, relocate irrigation ditches, install drainage systems or slurry cut-off walls.
	Establish uniform guidelines for protection and enhancement of existing habitat.	Coordinate maintenance and improvement actions with the Ecosystem Restoration Program Plan to enhance and restore habitat areas.
Promote integration of habitat restoration.	Establish criteria for including habitat restoration in levee enhancement and special projects.	Coordinate special improvement actions with the Ecosystem Restoration Program Plan to enhance and restore habitat areas.
Establish state, federal, and local cost-sharing plan to assure long-term Delta levee system integrity.	Identify necessary funding requirements and beneficiaries to provide equitable distribution of maintenance and improvement costs.	Develop a phasing sequence for implementation of proposed actions to improve flood protection.

This plan will build upon existing programs and activities to meet minimum federal flood control project levee performance criteria for project and non-project levees in the Delta. Historically, local reclamation districts have been responsible for maintaining and improving Delta levees and have provided the primary source of resources through assessments imposed on local property owners. In the past the

federal government has provided some resources for maintenance of federal flood control projects. The state increased its participation when it established the Delta Levee Maintenance Subvention Program and the Special Flood Control Project Program to address maintenance and improvement projects for certain areas of the Delta. Future funding for the Delta Levee System Integrity Program will be included as part of the overall financing strategy for the CALFED Bay-Delta Program. Please see Appendix B for more detailed information on this element of the program.

Delta Levee Special Improvement Projects

Implementation Objective	Target	Action
Provide early protection to important resources.	Identify public benefits provided by Delta islands and rank the islands by these attributes.	Develop a phasing sequence for implementation of proposed special projects and integration of habitat restoration actions.
Enhance flood protection for islands providing multiple resource benefits.	Improve stability of Delta levees and improve flood conveyance capacity.	Modify levee cross sections by raising levee height, widening levee crown, flattening levee slopes, or constructing stability berms. Modify channel configurations, constructing cut-off levees, and create bypass systems.
Promote integration of habitat restoration.	Establish criteria for including habitat restoration in levee enhancement and special projects.	Coordinate special improvement actions with the Ecosystem Restoration Program Plan to enhance and restore habitat areas.

These projects will provide increased flood protection beyond the Delta Levee Base Level Protection Plan for Delta islands which have many public benefits. The state increased its role in Delta levee flood control improvements when it established the Special Flood Control Project Program. Delta islands that protect water quality, agricultural production, life and personal property, cultural resources, recreation, the ecosystem, and local and statewide infrastructure, will be ranked separately for each of these resources.

Program staff, in coordination with stakeholders, the public, and state and federal agencies, will seek input in preparing island rankings. These rankings will be used by policy makers in developing an overall balanced priority plan for Delta Levee Special Improvement Projects. This priority plan will identify the relationships between the resources potentially affected by flooding of each Delta island and the phasing sequence of special improvement projects to provide increased flood protection. Please see Appendix C for more detailedinformation on this element of the program.

Delta Island Subsidence Control Plan

Implementation Objective	Target	Action
Reduce the risk to levee stability from subsidence.	Modify agricultural practices within 300-500 yards of landside levee slope to reduce subsidence.	Purchase conservation easements adjacent to levees.
		Implement less intensive agricultural practices.
	Identify demonstration projects to restore interior island elevations.	Implement pilot project for shallow flooding of peat soils.
		Implement pilot project to increase organic surface material.
	Identify areas critical for controlling subsidence and rank these areas for importance to protect public benefits.	Develop a phasing sequence for implementation of proposed subsidence control projects.
Promote integration of habitat restoration.	Establish criteria for including habitat restoration in subsidence control projects.	Coordinate subsidence control actions with the Ecosystem Restoration Program Plan to enhance and restore habitat areas.

This plan will promote island subsidence reduction to provide long-term reliability of Delta levees through coordination with existing program and activities. The state increased its role in subsidence investigations when it established the Special Flood Control Project Program.

Program staff, in cooperation with stakeholders, the public, and state and federal agencies, will evaluate subsidence rates and depth of organic soils for Delta islands, and will develop an implementation plan. This plan will identify actions and a phasing sequence to address island subsidence. Please see Appendix D for more detailed information on this element of the program.

Implementation Objective	Target	Action
Enhance response capabilities and resource allocation prior to disaster event	Identify guidelines for funding and participation	Purchase materials in advance and place in strategic locations.
		Develop contracts for equipment in advance
	Identify guidelines for multi-agency participation	Implement agreements for participation and coordination
Enhance response capabilities and resource allocation for recovery efforts following a disaster event	Identify repair and recovery criteria to coordinate and fund post-disaster efforts.	Identify resource area recovery and rehabilitation plans
		Prepare updated flood risk assessments.
Establish state, federal, and local cost-sharing plan to assure long-term Delta levee emergency management protection.	Identify necessary funding requirements and beneficiaries to provide equitable distribution of emergency management preparation and recovery costs.	Develop a phasing sequence for implementation of proposed emergency management actions.

This plan will build upon existing emergency management activities to protect critical Delta resources in the event of a disaster. The existing emergency management structure is designed to coordinate activities of multiple state, federal, and local agencies with varying responsibilities to provide emergency assistance in the event of a disaster. Program staff will work with stakeholders, the public, and state and federal agencies, in identifying pre-emergency and post-disaster recovery measures such as establishing a multi-agency emergency management team; and guidelines for participation and cooperation. Please see Appendix E for more detailed information for this element of the program.

Implementation Objective	Target	Action
Enhance understanding of how Delta levees react to earthquakes.	Perform analysis of recent seismic data.	Prepare updated seismic ground motion mapping, and updating seismic risk assessments. Perform dynamic testing of levee material properties, and levee stability analysis.
Improve performance of the Delta levee system during an earthquake.	Improve stability of Delta levees by cost-effective measures to improve performance during an earthquake	Modify levee cross sections by raising levee height, widening levee crown, flattening levee slopes, or constructing stability berms.
Establish an implementation plan for seismic actions.	Identify areas critical for improving seismic performance of Delta levees.	Develop a phasing sequence for implementation of proposed seismic actions.

This assessment will identify and increase the understanding of the risk to Delta resources during catastrophic seismic events and develop recommendations to improve the stability of Delta levees.

To define further the relative risk of catastrophic events and the performance of Delta levees, the Department of Water Resources' Seismic Investigation may be continued. This investigation consists of installing strong-motion accelerometers at three to four levee sites in the Delta; creating a geologic model for deeper soil deposits; ongoing field and laboratory testing to better determine the static and dynamic properties of organic soils; field and laboratory testing to better determine liquefaction potential; and investigation of the potential activity of the Coast Range-Sierra/Nevada Boundary Zone.

Program staff will work in cooperation with stakeholders, the public, and state and federal agencies, to build upon existing seismic information and activities to prepare an implementation plan. This plan will identify outstanding issues requiring subsequent action, implement and coordinate recommendations with other program actions, and enhance coordination between agencies, stakeholders, andthe public. Please see Appendix F for more detailed information for this element of the program.

Related Program Activities

The CALFED Ecosystem Restoration Program Plan will address special habitat improvements, levee associated habitat, Delta in-channel islands, and beneficial reuse of dredge material which were formerly included as elements of the Delta Levee System Integrity Program. In addition, the conveyance/storage elements of the proposed CALFED Bay-Delta Program alternatives will address Delta recreation which was formerly included as an element of the Delta Levee System Integrity Program. However, these areas will continue to be considered in development of each area of the CALFED Bay-Delta Program. The Delta Levee System Integrity Program actions will be closely integrated with the Ecosystem Restoration Program Plan and Delta conveyance improvements that simultaneously improve Delta levee system performance, increase ecosystem quality, and protect water quality and water supply reliability.